
Development, Implementation, and Analysis of an Environmental Simulation Information Reference Library and Archive (ESIRLA)

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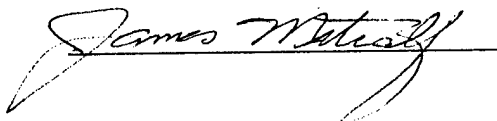
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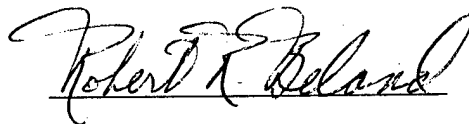


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This technical report has been reviewed and is approved for publication.

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FOREWORD

Science and Technology Corporation (STC) is pleased to submit this final summary report entitled "Development, Implementation, and Analysis of an Environmental Simulation Information Reference Library and Archive (ESIRLA)" by John Burgeson under Contract No. F19628-95-C-0005 of the same name. The period of performance was 15 November 1994 through 14 November 1997.

STC wishes to acknowledge the support and valuable assistance of the many individuals who were involved in the work performed under this contract. Several are named in the formal reports published during the contract period of performance. In particular, the consistent technical and administrative support of Mr. Donald Grantham, COTR for this contract, is hereby gratefully acknowledged.

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1. FUNDED TASKS

Science and Technology Corporation (STC) has completed all the tasks funded under Contract No. F19628-95-C-0005. Quarterly status reports have been submitted in accordance with contract requirements. The following paragraphs summarize the work completed during the course of the contract.

1.1 E²DIS Project

As part of the Environmental Effects for Distributed Interactive Simulations (E²DIS) Project, STC conducted a systematic survey of the DoD environmental science community to determine cloud modeling and other environmental capabilities that support, or could potentially support, military modeling and simulation (M&S) efforts. STC also completed a survey of the DoD M&S community to determine its requirements for environmental data and environmental effects models. For both surveys, a PC-based relational database was developed with commercial software to store and manage the surveyed information. STC personnel separately analyzed the results of the two surveys and documented the analyses in formal reports. The reports and databases were delivered to PL/GPAA.

Capabilities Survey

In accomplishing this survey, STC's Survey Team

- (i) Performed the background research needed to design, develop, and implement a comprehensive environmental capabilities questionnaire to survey the DoD environmental modeling and database community;
- (ii) Conducted the survey and analyzed its results to determine the capabilities of the environmental modeling and database community.
- (iii) Incorporated the results of this analysis into two draft reports: the *Environmental Model and Database Catalog*, and the *Analysis and Required New Capabilities Document*. The former document described and compiled a listing of the environmental models and databases developed or used by the military services; the latter assessed those environmental models and databases by comparing them with the requirements of the M&S community.

Requirements Survey

To accomplish this survey, the Survey Team

- (i) Ensured that all major environmental requirements for models and databases that specify the near-earth, atmosphere, and near-space had been identified.
- (ii) Carefully quality controlled the database with indepth follow-up interviews (in person, telephone, telefax, or E-mail) with all points-of-contact as designated on the returned questionnaires.
- (iii) Analyzed the survey's preliminary results to determine the environmental requirements of the DoD M&S community.
- (iv) Prepared a paper on the results of the E²DIS survey of the DoD M&S community's environmental requirements, and presented the paper at the 13th DIS Workshop.
- (v) Prepared and delivered for review a draft of the *Tri-Service Environmental Simulation Requirements Document*. The E²DIS Survey Team formally reviewed the draft document while the team's members attended the Workshop (September 1995).

Survey Reports

The E²DIS Survey Team completed a final review of the three reports discussed above. Although these reports could have individually stood alone, they were published as a three-part set: *Natural Environmental Effects in Military Models and Simulations: Part I—A Survey of Requirements*; *Natural Environmental Effects in Military Models and Simulations: Part II—A Survey of Capabilities*; and *Natural Environmental Effects in Military Models and Simulations: Part III—An Analysis of Requirements Versus Capabilities*. STC documented the database management systems containing the information obtained from the E²DIS Requirements and Capabilities Survey Questionnaires, and delivered the documentation and both databases to PL/GPAA for distribution.

1.2 CIDOS Tri-Service Conferences

STC planned, made all arrangements for, and held two tri-service Cloud Impacts on DoD Operations and Systems (CIDOS) conferences, CIDOS-95 and CIDOS-97. The conferences enhanced the exchange of information on the most current cloud modeling techniques and applications for the benefit of the DoD environmental science community.

- (i) The theme for CIDOS-95, held on 24–26 October 1995 at Hanscom AFB, was *Cloud Modeling and Data for Defense Activities*, which emphasized sufficient physical reality in simulating clouds. STC produced a 250-page preprint of conference presentations and provided a copy on site to each of the more than 125 attendees.
- (ii) The theme for CIDOS-97, held 22–25 September 1997 at the Naval War College in Newport, RI, was *Cloud Effects on War Gaming, Modeling and Simulations*. STC Produced a 276-page preprint of conference presentations and provided a copy on site to each of the more than 100 attendees.

1.3 Weather Effects Products for EO Systems

STC determined the detailed requirements for weather effects products and decision aids for specific Air Force operational electro-optical (EO) systems. A final report was prepared on an analysis of the identified weather effects requirements for EO systems, including conclusions and recommendations for follow-on actions. STC provided and documented the database of the information collected during the requirements identification process. This work included the following activities:

- (i) Developed data collection sheets, designed the database, and developed lists of EO systems and cognizant user / developer.
- (ii) Made more than 50 separate individual contacts throughout the survey period to collect EO weather requirements from system operators (pilots), weather support personnel, and planners/developers of various C⁴I systems. Identified weather effects requirements for EO systems and developed a database of the information collected during the requirements identification process. Provided a preliminary summary of the results to LtCol Alleca, who used them at the Theater Battle Management (TBM) meeting in November 1995.
- (iii) Completed a PC-based relational database management system (developed with commercial software) containing the information collected on weather effects requirements for EO systems. Analyzed the identified requirements, developed conclusions and recommendations for follow-on actions, and submitted for review a

draft report entitled *Survey of Requirements for Weather Impact Decision Aids for Electro-Optical Systems*.

- (iv) Published report PL-TR-2066, entitled *Survey of Requirements for Weather Impact Decision Aids for Electro-Optical Systems* by Carl H. Chesley, J. Burgeson, and P. Try, February 1996. The report contains an analysis of the identified requirements for weather effects products and decision aids for specific Air Force operational EO systems. Prepared a database description of the information collected during the requirements identification process.

1.4 Outreach Program for PL/GP

STC compiled information for and developed a draft concept of an outreach program for PL/GP activities associated with weather and cloud impact research and development underway at PL/GP. STC personnel prepared and delivered an example briefing of the capabilities there.

1.5 THUNDER and EADSIM

STC researched the literature provided by PL/GP-M to prepare an interim report, *The Use of "Weather" in THUNDER and EADSIM*, on how environmental effects are accounted for in these two models. THUNDER accounts for two weather factors only: ceiling and visibility. These are allowed to affect probabilities of target acquisition, discrimination and kill, depending on the type of aircraft/weapon system combination. Weather is user provided in the form of scripts that specify actual and forecast ceilings and visibility. EADSIM does not account for weather. After PL/GP-M reviewed the report, STC published PL-TR-2285, *Weather Effects in Selected Air Warfare Simulations*.

1.6 Cloud Information Reference Library Archive

STC designed, tested, and published the Cloud Information Reference Library Archive (CIRLA) on the World Wide Web. The abstracts from the CIDOS-95 conference preprint volume were used to prepare Web pages for access from the CIRLA Home Page.

1.7 Weather Effects on EO Sensors for Conventional Weapons

STC extended the research of the literature to weather effects on electro-optical (EO) sensors used on precision-guided munitions. In this area of research, STC

- (i) Reported on weather effects in conventional weapons allocation models, which recently have been combined into the Conventional Forces Assessment Model (CFAM).
- (ii) Prepared a plan to use CFAM to determine the military value of incorporating weather information from environmental data records simulated from two experimental satellite systems. The plan included simulating an EO "visibility" that accounts for the weather's effect on employing EO weapon systems.
- (iii) Delivered a draft report entitled *Simulating the Use of Environmental Data in an Air-to-Ground Campaign* on 7 November 1997.

2. REPORTS AND DATABASES

During the course of the contract, STC delivered formal reports, and databases as well as a number of draft reports and conference preprint volumes. The formal reports and the databases are listed.

PL-TR-96-2029, Natural Environmental Effects in Military Models and Simulations: *Part I—A Survey of Requirements*

PL-TR-96-2040, Natural Environmental Effects in Military Models and Simulations: *Part II—A Survey of Capabilities*

PL-TR-96-2039, Natural Environmental Effects in Military Models and Simulations: *Part III—An Analysis of Requirements Versus Capabilities*

PL-TR-96-2066, Survey of Requirements for Weather Impact Decision Aids for Electro-Optical Systems

PL-TR-97-285, Weather Effects in Selected Air Warfare Simulations

The E²DIS Project Capabilities Survey Database

The E²DIS Project Requirements Survey Database

Database of Surveyed Requirements for Weather Impact Decision Aids for Electro-Optical Systems